

# Claims

- [c1] 1.A photodiode detector assembly for use with an ionizing radiation detector, the assembly comprising:  
a first layer comprising a first side and a second side and an array of backlit photodiodes disposed at the second side; and  
a second layer disposed proximate to and opposing the second side of the first layer, the second layer comprising thru vias;  
wherein light rays entering the first layer at the first side and impinging the backlit photodiodes at the second side result in electrical signals at the thru vias of the second layer, thereby providing electrical output signals from the backlit photodiodes at a distance from the backlit photodiodes.
- [c2] 2.The assembly of Claim 1, wherein the thickness of the first layer is equal to or less than about 150 microns.
- [c3] 3.The assembly of Claim 2, wherein the thickness of the first layer is equal to or less than about 100 microns.
- [c4] 4.The assembly of Claim 3, wherein the thickness of the first layer is equal to or less than about 50 microns.

- [c5] 5.The assembly of Claim 3, wherein the thickness of the first layer is equal to or greater than about 25 microns.
- [c6] 6.The assembly of Claim 2, wherein the first layer is mechanically bonded and electrically connected to the second layer.
- [c7] 7.The assembly of Claim 6, wherein the first and the second layers each comprise silicon.
- [c8] 8.The assembly of Claim 7, wherein the first and the second layers are joined using solder balls, conductive epoxy dots, cold fusion between metal pads, or any combination of joints comprising at least one of the foregoing.
- [c9] 9.The assembly of Claim 1, wherein the thru vias extend from a front side of the second layer to an opposing back side of the second layer.
- [c10] 10.The assembly of Claim 1, further comprising:  
a third layer comprising a printed circuit board having electrical connections on a first board surface that extend through to a second board surface, the electrical connections on the first board surface arranged for signal communication with the thru vias, and the electrical connections on the second board surface arranged for

signal communication with at least one electronic component.

[c11] 11.The assembly of Claim 1, wherein the array of backlit photodiodes includes neighboring backlit photodiodes having a cell-to-cell signal crosstalk of equal to or less than about 4%.

[c12] 12.The assembly of Claim 1, wherein the array of backlit photodiodes includes neighboring backlit photodiodes having a cell-to-cell signal crosstalk of equal to or less than about 2%.

[c13] 13.An ionizing radiation detector, comprising:  
a photodiode detector assembly comprising:  
a first layer comprising a first side and a second side and  
an array of backlit photodiodes disposed at the second side; and  
a second layer disposed proximate to and opposing the second side of the first layer, the second layer comprising thru vias; and  
a scintillator disposed at the first side of the first layer, the scintillator comprising:  
a radiation input surface and a radiation output surface wherein the scintillator produces light rays exiting at the output surface in response to radiation incident at the input surface, the light rays exiting at the output surface

being incident on the first side of the first layer of the photodiode detector assembly;  
wherein light rays entering the first layer at the first side and impinging the backlit photodiodes at the second side result in electrical signals at the thru vias of the second layer, thereby providing electrical output signals from the backlit photodiodes at a distance from the backlit photodiodes.

- [c14] 14.The detector of Claim 13, wherein the thickness of the first layer is equal to or greater than about 25 microns and equal to or less than about 150 microns.
- [c15] 15.The detector of Claim 13, wherein the thickness of the first layer is equal to or less than about 100 microns.
- [c16] 16.The detector of Claim 13, wherein the first and the second layers each comprise silicon and the first layer is mechanically bonded and electrically connected to the second layer.
- [c17] 17.The detector of Claim 14, wherein the array of backlit photodiodes includes neighboring backlit photodiodes having a cell-to-cell signal crosstalk of equal to or less than about 4%.
- [c18] 18.The detector of Claim 15, wherein the array of backlit photodiodes includes neighboring backlit photodiodes

having a cell-to-cell signal crosstalk of equal to or less than about 2%.

[c19] 19. The detector of Claim 13, wherein the thru vias extend from a front side of the second layer to an opposing back side of the second layer, and further comprising: a third layer comprising a printed circuit board having electrical connections on a first board surface that extend through to a second board surface, the electrical connections on the first board surface arranged for signal communication with the thru vias, and the electrical connections on the second board surface arranged for signal communication with at least one electronic component.